

# **PS Irradiations for Pixel Electronics**

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## **Summary of PS Schedule:**

- Available Periods this Year

## **Proposed Irradiation Program:**

- Analog Test Chip
- PM Bar + LVDS buffer
- MCC-D0 + opto-chips and opto-links

## Irradiation Periods at PS

### Present Schedule for LHC Irradiation Periods (ATLAS+CMS):

- Mon 10 Apr at 8h to Mon 1 May at 8h(16d+16h)
- Mon 22 May at 8h to Sun 4 Jun at 0h(12d+16h)
- Mon 19 Jun at 8h to Mon 17 Jul at 8h (28d+0h)
- Mon 17 Jul at 8h to Mon 14 Aug at 8h (28d+0h)
- Mon 14 Aug at 8h to Sun 10 Sep at 0h(26d+16h)
- Mon 9 Oct at 8h to Mon 13 Nov at 8h (35d+0h)

### Original Plan:

- Would begin significant irradiations of FE-D in April period, to have assemblies ready for May H8 running.

### Overview:

- Beam size is about 1 x 2 cm. A fluence of roughly  $2 \times 10^{15}$  p/cm<sup>2</sup> can be delivered in a week (roughly 50MRad). There is only one significant access per week.
- April run would naturally divide into about 3 periods of one week each. This would allow accumulating 10, 30, and 50MRad doses in these periods.

## New Proposal:

- Prepare Analog Test chips (Bonn), LVDS buffers (CPPM), and PM bars (CPPM) for irradiation in April period. This requires some simple PC boards to allow PM bars to be biased for worst case (transistors with field across gate oxide), LVDS buffer chip to be operated with something like a clock, and the Analog Test chip to operate in a standard way with computer control.
- Genova and Wuppertal are beginning work on an optolink testboard which would include space for a (GEC, OSU, or Taiwan) opto-package, (SCT or pixel) DORIC and VDC chips, and MCC-D0. This would allow testing of the opto-link and opto-chips in “stand alone” mode, and also to use the MCC-D0 to implement a “loop-back” mode. Schematics should be ready for review in the near future.
- Will probably add cards with Flex passive components to do first tests (LBL).

## Additional work:

- Will need to complete support stand for supporting test cards (P. Sicho and J. Thadome). Proposal would be to standardize roughly on cards which are the same size as the single chip support cards (10 x 10 cm). There is already a sketch for such a support stand, about 30 cm in length and supporting 10-15 PC boards. This would be mounted on top of the scanning stage that should be dedicated to pixel use during all LHC PS irradiation periods.

- Responsible groups above would then need to put together the appropriate PC boards to allow at least minimal testing during irradiation. A total of about 3 cards of each type (at most) could be foreseen. The chips should all be mounted in the central 1-2 square cm of the card in order to receive a full dose (may be difficult for opto-testing unless mount only bare die).
- During the periods of reduced total dose, some scanning could be done to provide reduced dose over larger area. Since there is only a single scanning table, all users would have to agree on this protocol.
- Could probably tolerate 10-15 cards in beam at the same time, depending on the material on each card. Ceramic packages with gold lids are not ideal...

## Operation:

- Shortest path from support stand to control room is about 10 meters. Some (limited) electronics could be placed 5 meters away by installing it in the access corridor just before it exits into the zone. Power supplies and commercial electronics should go at the full 10 meter distance.
- Cool box should be ready. We need to decide on temperature protocols also. Ideally, would irradiate cold (-10 C), and store cold (-20 C). After characterization “with no annealing” (limited time at 20 C or above), would then perform an anneal cycle to simulate low-dose irradiation and lifetime effects (usual spec is 100 C for 168 hours). Some parts may not work without anneal cycle.

- Prefer that we can make some measurements during irradiation. This is particularly useful when devices fail part way through the irradiation period...

## Doses:

- Pixel lifetime dose now estimated to be 50MRad. DMILL is only qualified to 10MRad during production. We have little experience at higher doses.
- SCT and others have significant experience up to 10MRad and  $10^{14}$  n equivalent.
- Suggest that we irradiate devices to 10, 30, and 50MRad in order to study evolution beyond the present knowledge. This corresponds approximately to total fluences of 4, 12, and  $20 \times 10^{14}$  protons/cm<sup>2</sup> in the PS.

## Petr Sicho should coordinate all of this work:

- He will return from UK to CERN in early March to initiate all preparations.
- He also warns that in principle, we should install the full cable plant for this year prior to the April run. However, I would have thought that the additional cabling which we need for FE-D irradiations is so limited that we can install these cables during short accesses before the runs start.
- One issue is that the background radiation level during accesses is relatively high, so the time that one can remain in the zone is very limited. Good preparation is essential...